Reviews, Tables, and Plots

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Advisory Committee Meeting
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First, my fascinating biennial overview of changes in REVIEWS, TABLES, AND PLOTS!

Constants, Units, Atomic and Nuclear Properties

1. Physical constants (revised)
2. Astrophysical constants (revised—WMAP3)
3. International System of Units (SI)
4. Periodic table of the elements (revised)
5. Electronic structure of the elements (revised!)
6. Atomic and nuclear properties of materials (NEW `AtomicNuclearProperties`)
7. Electromagnetic relations (transmission lines revised)
8. Naming scheme for hadrons

Private version to be nationalized shortly

Standard Model and Related Topics

9. Quantum chromodynamics (revised)
10. Electroweak model and constraints on new physics (revised)
11. The Cabibbo-Kobayashi-Maskawa quark-mixing matrix (NEW)
12. CP violation (revised)
13. Neutrino mass, mixing, & flavor change (revised)
14. Quark model (revised)
15. Grand Unified Theories (revised)
16. Structure functions (revised)
17. Fragmentation functions in e^+e^- annihilation (revised)

Astrophysics and cosmology

18. Experimental tests of gravitational theory (revised)
19. Big-Bang cosmology (revised—WMAP3)
20. Big-Bang nucleosynthesis (revised)
21. The cosmological parameters (revised—WMAP3)
22. Dark matter (revised)
23. Cosmic microwave background (revised—WMAP3)
24. Cosmic rays (revised) (Needs rewritten, but there are chronic problems)

Experimental Methods and Colliders

25. Accelerator physics of colliders (revised; 2008 rewrite promised)
26. High-energy collider parameters (revised)
27. Passage of particles through matter (revised—3 new sections)
28. Particle detectors (revised)
29. Radioactivity and radiation protection (revised; 2008 rewrite promised)
30. Commonly used radioactive sources

Mathematical Tools or Statistics, Monte Carlo, Group Theory

31. Probability
32. Statistics (revised)
33. Monte Carlo techniques (revised)
34. Monte Carlo particle numbering scheme (revised)
35. Clebsch-Gordan coefficients, spherical harmonics, and d functions
36. SU(3) isoscalar factors and representation matrices
37. SU(n) multiplets and Young diagrams

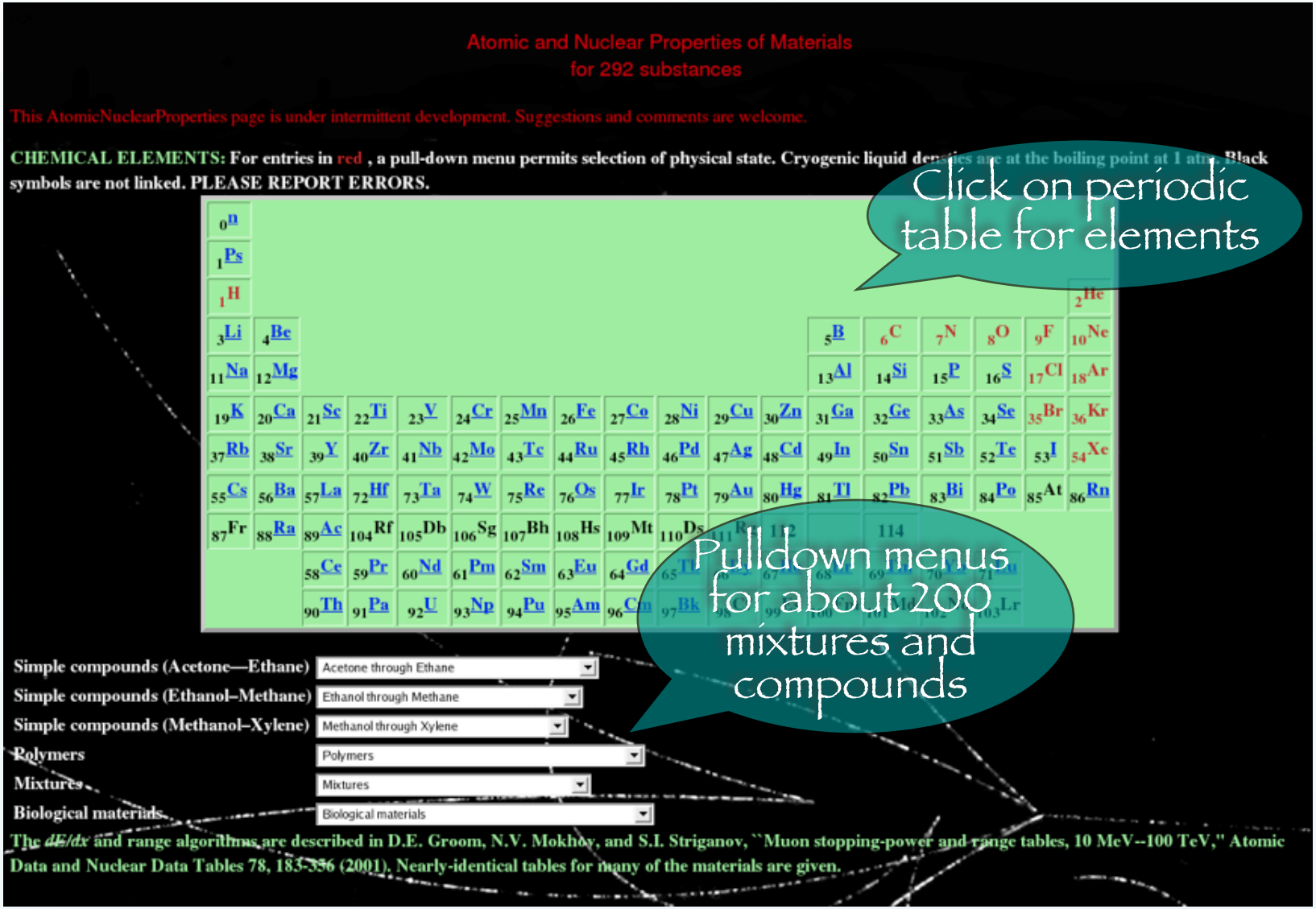
Kinematics, Cross-Section Formulae, and Plots

38. Kinematics
39. Cross-section formulae for specific proc. (revised)
40. Plots of cross sections and related quantities (revised)

In summary:

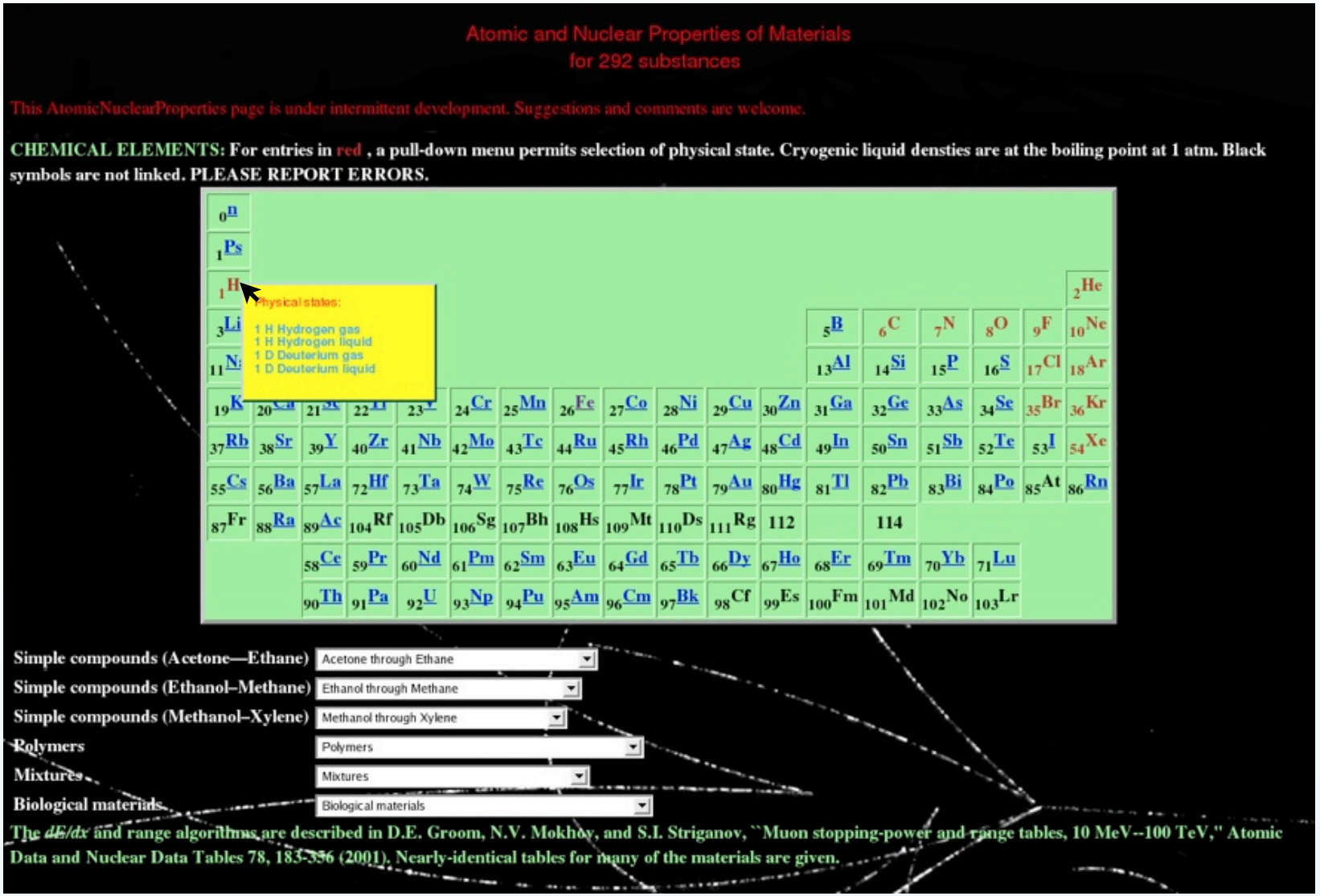
- 83% of the 40 REVIEWS, TABLES, AND PLOTS are new or revised for 2006
- If the 60 minireviews (of various majorness) are included, 70% of the 100 items are new or revised for this edition

A big upgrade of AtomicNuclearProperties---
(close to being the official version)



(Can be found at `/home/sierra/~deg/AtomicNuclearProperties`)

Gases and a few others (in red) have properties for different physical states



(Can be found at `/home/sierra/~deg/AtomicNuclearProperties`)

Now table format and with several new features---

Atomic and nuclear properties of materials:

Iron (Fe)

Quantity	Value	Units	Value	Units
Atomic number	26			
Atomic mass	55.845	g mole^{-1}		
Density	7.87	g cm^{-3}		
Minimum ionization	1.451	MeV g^{-1}cm^2	11.43	MeV cm^{-1}
Radiation length	13.84	g cm^{-2}	1.757	cm
Nuclear collision length	81.7	g cm^{-2}	10.37	cm
Nuclear interaction length	132.1	g cm^{-2}	16.77	cm
Critical energy (e$^-$)	21.81	MeV		
Molière radius	13.45	g cm^{-2}	1.709	cm
Muon critical energy	347.	GeV		
Melting point	1811.	K	1538.	C
Boiling point @ 1 atm	3134.	K	2861.	C

For some things

Explanation of some entries

Table of muon *dE/dx* and Range: PS PDF TEXT

Table of isotopes

x ray mass attenuation coefficients

As before

Atomic and nuclear properties of materials:

Acetone (CH_3CHCH_3)

Quantity	Value	Units	Value	Units
<Z/A>	0.55097			
Density	0.790	g cm^{-3}		
Minimum ionization	2.003	MeV g^{-1}cm^2	1.582	MeV cm^{-1}
Radiation length	41.27	g cm^{-2}	52.25	cm
Nuclear collision length	57.5	g cm^{-2}	72.75	cm
Nuclear interaction length	81.4	g cm^{-2}	103.0	cm
Critical energy (e$^-$)	(Pending)	MeV		
Molière radius	(Pending)	g cm^{-2}	(Pending)	cm
Muon critical energy	1160.	GeV		

Composition:

Elem	Z	Atomic frac*	Mass frac
H	1	6.00	0.104122
C	6	3.00	0.620405
O	8	1.00	0.275473

* calculated from mass fraction data.

Explanation of some entries

Table of muon *dE/dx* and Range: PS PDF TEXT

Astrophysics and cosmology:

After nontrivial revision, there was an 11th hour emergency update to include the newly published WMAP3 results.

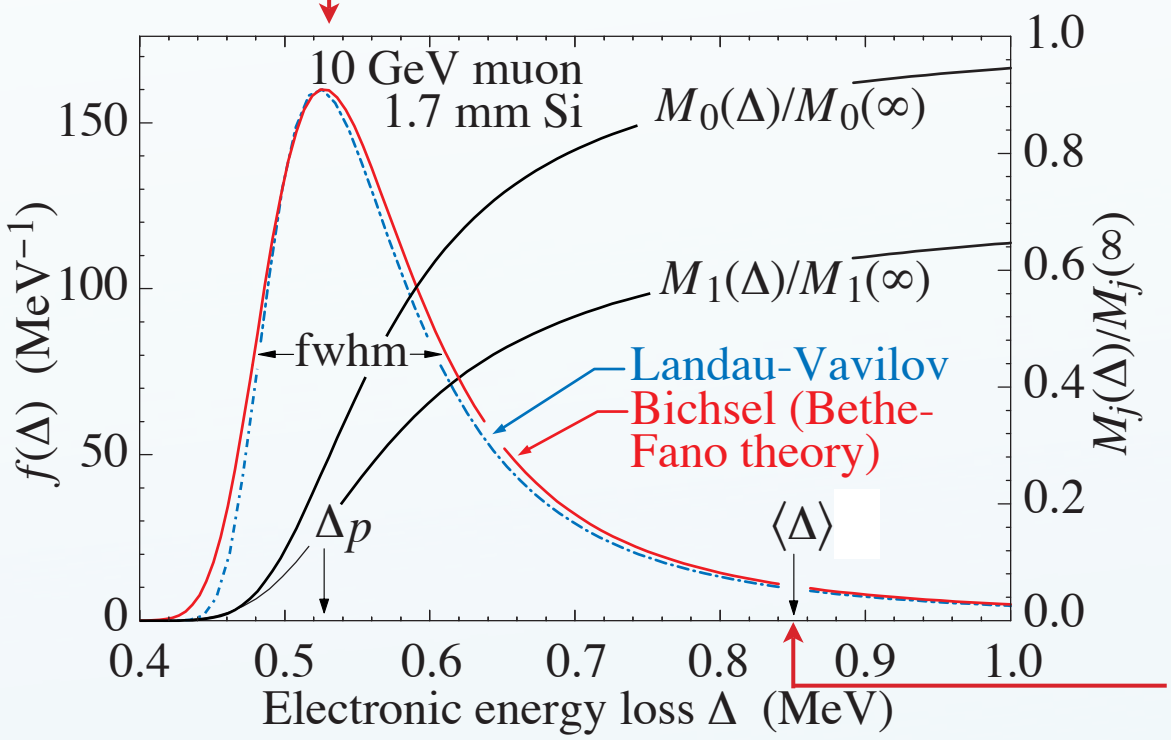
⇒ The new results are more definitive, with improved errors, but not different.

Keith Olive not only co-authors "Big-Bang Cosmology," but coordinates and oversees all the others.* I'm just a spectator.

* Except for Thibault Damour's "Experimental tests of relativity", which is self- propelled, and "Cosmic rays," which is a major problem

Passage of particles through matter:

A minor-looking change which we will be further improved in 2008



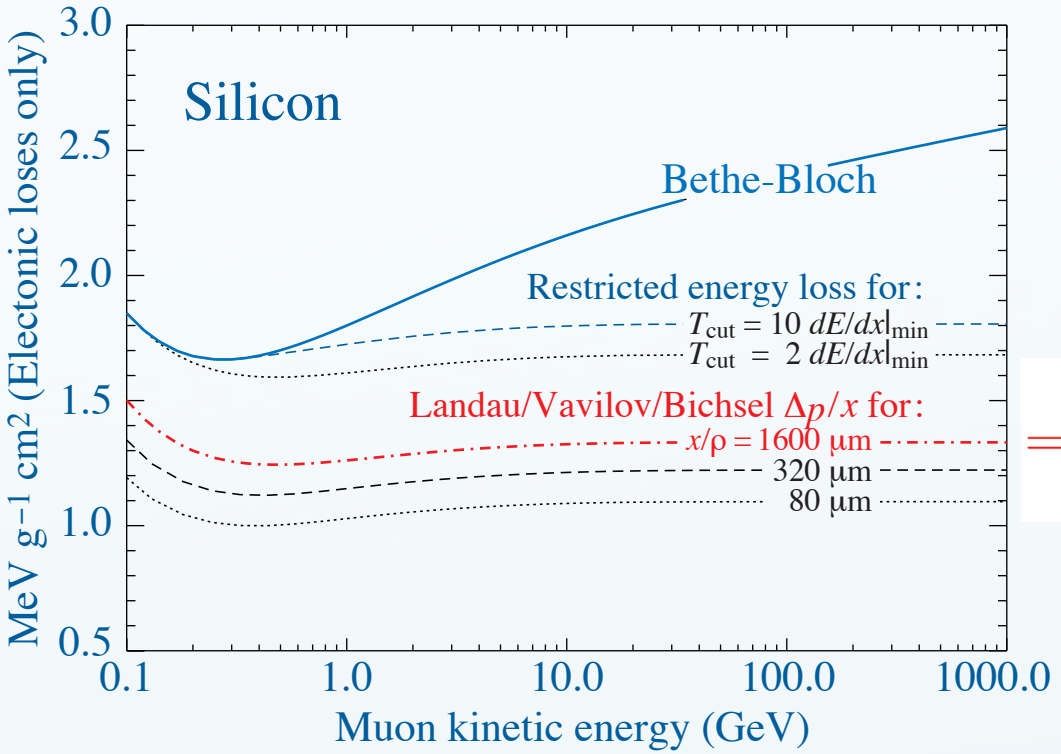
Most probable energy loss is ≈ independent of γ at "normal" test-beam energies

(Figure is for RPP08)

Bethe-Bloch $|dE/dx|$ increases with ln γ because of more δ-rays "way out in the tail"

"The expression *dE/dx* should be abandoned; it is never relevant to the signals in a particle-by-particle analysis"

-- Hans Bichsel [NIM A 562 (2006) 154-197]



$$\Longrightarrow C\frac{1}{\beta^2}\left[\ln\frac{2m_e c^2\, C\, x}{(\hbar\omega_p)^2} + 0.200\right]$$

Particle detectors: Changes long on the to-do list have been made!

The most substantial addition is "Photon Detection"

Authors: Dhiman Chakraborty (Northern Illinois U; FNAL), and
Takayuki Sumiyoshi (Tokyo Metropolitan U).
Almost-author referees: John Elias, Peter Denes

Sample of the new section's scope:

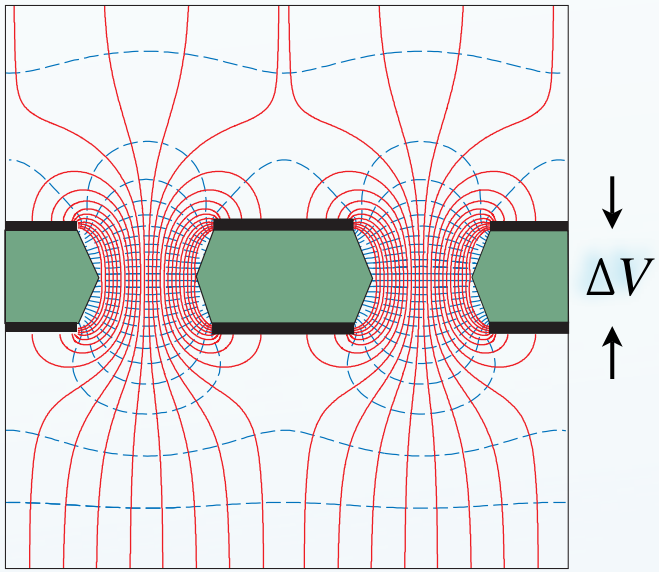
Table 28.2: Representative characteristics of some photodetectors commonly used in particle physics. The time resolution of the devices listed here vary in the 10–2000 ps range.

Type	λ (nm)	$\epsilon_Q\,\epsilon_C$	Gain	Risetime (ns)	Area (mm^2)	1-p.e noise (Hz)	HV (V)	Price (USD)
PMT*	115–1100	0.15–0.25	10^3–10^7	0.7–10	10^2–10^5	10–10^4	500–3000	100–5000
MCP*	100–650	0.01–0.10	10^3–10^7	0.15–0.3	10^2–10^4	0.1–200	500–3500	10–6000
HPD*	115–850	0.1–0.3	10^3–10^4	7	10^2–10^5	10–10^3	$\sim 2\times10^4$	∼600
GPM*	115–500	0.15–0.3	10^3–10^6	$O(0.1)$	$O(10)$	10–10^3	300–2000	$O(10)$
APD	300–1700	∼0.7	10–10^8	$O(1)$	10–10^3	1–10^3	400–1400	$O(100)$
SiPM	400–550	0.15–0.3	10^5–10^6	~ 1	1–10	$O(10^6)$	30–60	$O(10)$
VLPC	500–600	∼0.9	$\sim 5\times10^4$	~ 10	1	$O(10^4)$	∼7	∼1

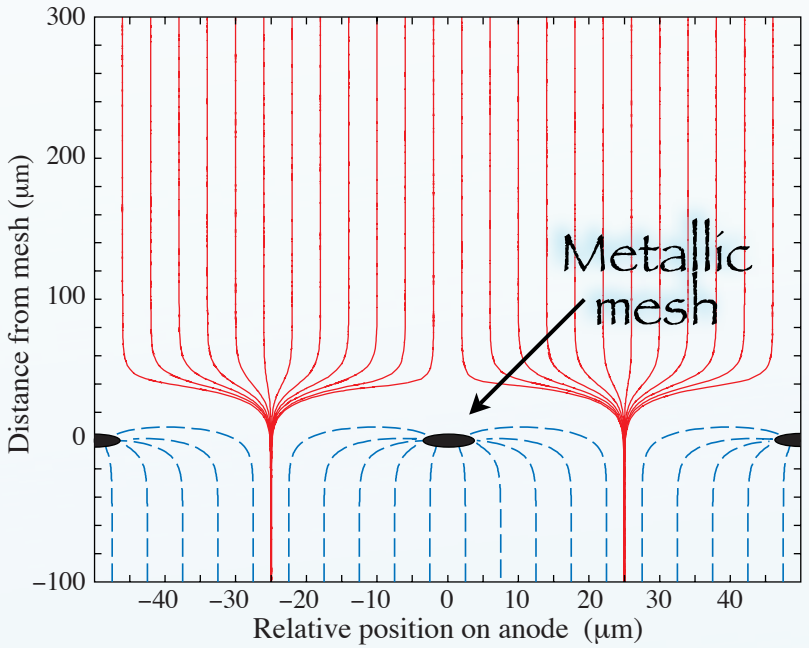
*These devices often come in multi-anode configurations. In such cases, area, noise, and price are to be considered on a "per readout-channel" basis.

Two new micro-pattern gas detectors (MPGD's) (Mike Ronan):

Gas-electron multiplier (GEM)

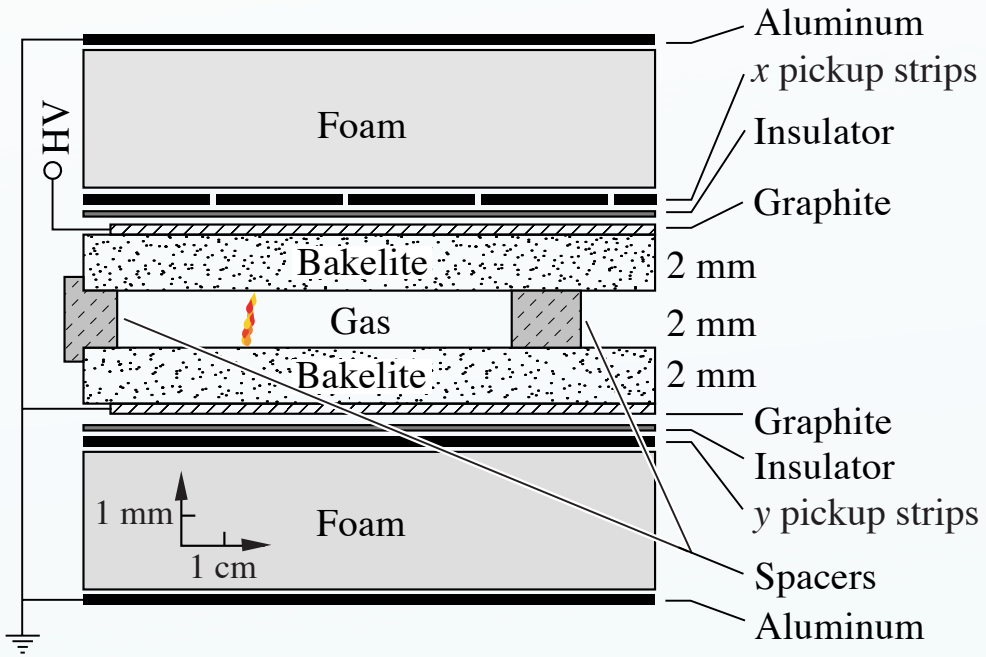


Micromegas



Supply substantial amplification, direct electron signals, and suppression of positive-ion feedback; useful in TPC's and other gas detectors

And the resistive plate chamber (RPC) the Advisory Committee has been beating me up about for so long!
(Henry Band, J. Zhang)



Finally, progress but No Cigar Yet on the modernization of hadron calorimetry

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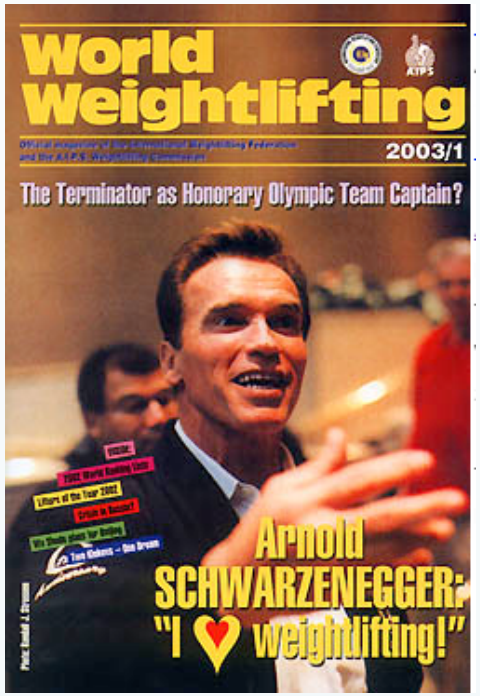
After all these years, Groom's paper is in process with NIM A. Richard Wigmans has agreed to collaborate with him on the new section for RPP08



26 (!) pages for the axion minireview?

Thank you!